CHAPTER I – OPERATIONAL PROCEDURES

1. GENERAL

Services provided by the Joint Typhoon Warning Center (JTWC) include forecasts of tropical cyclone formation, intensity, direction and speed of movement, and extent of damaging winds. This information was disseminated in 1972 by: (1) the Tropical Cyclone Formation Alert issued when formation of a tropical cyclone was suspected; (2) tropical cyclone warnings issued four times daily whenever a significant tropical cyclone was observed in the JTWC primary area; and (3) tropical cyclone warnings issued twice daily whenever a significant tropical cyclone was observed in the JTWC secondary area.

FLEWEACEN Guam provides computer and meteorological/oceanographic analyses for the JTWC. Communications support is furnished by the Nimitz Hill Message Center of the Naval Communications Station, Guam.

2. ANALYSES AND DATA SOURCES

a. FLEWEACEN GUAM ANALYSES:

(1) Surface mercator analysis, Northern Hemisphere, Western Pacific area; 0000Z, 0600Z, 1200Z, and 1800Z.

(2) Surface micro-analysis of South China Sea region; 0000Z, 0600Z, 1200Z, and 1800Z.

(3) Surface mercator analysis, Northern and Southern Hemispheres, Western Pacific and Indian Ocean area; 0600Z and 1800Z.

(4) Sea surface temperature charts; daily.

b. JTWC ANALYSES:

(1) Gradient level (3,000 feet) streamline analysis (south of 20°N) and isobaric analysis (north of 20°N); 0000Z and 1200Z.

(2) 700-mb, 500-mb, and 200-mb contour and streamline analysis; 0000Z and 1200Z.

(3) Reconnaissance data. Observations from weather reconnaissance aircraft are plotted on large-scale sectional charts.

(4) Time cross sections of selected tropical stations.

(5) Time sections of surface reports for selected tropical stations.

(6) Additional and more frequent analyses similar to those above during periods of tropical cyclone activity.

c. SATELLITE DATA:

Satellite data played a major role in the early detection of tropical cyclones in 1972. This aspect, as well as applications of satellite data to tropical cyclone tracking, is discussed in Chapter II, Reconnaissance and Communications.

d. RADAR:

Land radar reports, when available, were used for tracking tropical cyclones during the 1972 typhoon season. Once a storm moved within range of a land radar site, reports were usually received hourly. Use of radar during 1972 is treated in Chapter II, Reconnaissance and Communications.

e. COMPUTER PRODUCTS:

During 1971 the FLEWEACEN Guam computer was equipped with a varian plotter. This device eliminated a significant portion of the former hand plotting effort. Varian charts are produced routinely at synoptic times for the surface, 700-mb, and 500-mb levels. Additionally, a chart which approximates the 200-mb level is also produced. This chart uses rawinsonde data at 200 mb and aireps above 33,000 feet and within six hours of the 0000Z and 1200Z synoptic times. Data not in the proper format for use by the computer are hand plotted on the charts. These include pibal gradient level winds, low cloud movement, and missing or late synoptic reports necessary for a detailed analysis.

In addition, the standard array of synoptic-scale computer analyses and prognostic charts is produced.

JTWC extensively utilizes the computer center for objective typhoon forecasts and for statistical post analysis.

3. FORECAST AIDS

a. CLIMATOLOGY:

The following climatological publications were utilized:

(1) Tropical Cyclones in the Western Pacific and China Sea Area (Royal Observatory, Hong Kong), covering 70 years of typhoon tracks.

(2) Intensity Changes of Tropical Storms and Typhoons of the Western North Pacific Ocean (Brand and Gaya, 1971) NAVWEARSCHFAC Tech Paper No. 5-71.

(3) Climatological 24-Hour Typhoon Movement (McCabe, J. T., 1961).

(4) Western Pacific Typhoon Tracks, 1950-1959 and 1959-1968 (FWC/JTWC).

(5) Far East Climate Atlas (1st Weather Wing, February 1963).

(6) Annual Typhoon Reports, 1959-1971 (FWC/JTWC).

(7) A Climatology of Tropical Cyclones and Disturbances of the Western Pacific with a Suggested Theory for Their Genesis/Maintenance (Gray, Wm., 1970) NAVWEARSCHFAC Tech Paper No. 19-70.

(8) Changes in the Characteristics of Typhoons Crossing the Philippines (Brand and Blelloch, 1972) ENVPREDRSCHFAC Tech Paper No. 6-72.

(9) Speed of Tropical Storms and Typhoons After Recurvature in the Western North Pacific Ocean (Burroughs and Brand, 1972) ENVPREDRSCHFAC Tech Paper No. 7-72.

(10) The Typhoon Analog Computer Program (TYFOON).

b. PERSISTENCE:

Extrapolation of storm movement using 12-hour mean speed and direction was the most reliable objective method for 24-hour forecasts.

c. OBJECTIVE TECHNIQUES:

During 1972 the following objective forecasting methods were employed:

(1) ARAKAWA - surface pressure grid model.

(2) TYRACK - based on program-selected best steering level from FLEWEACEN Pearl tropical fields.

(3) TSGLOB - modification of TYRACK using global band upper air fields (GBUA) from FLENUMWEACEN Monterey. It replaced TYRACK on 23 September 1972 when FLEWEACEN Pearl tropical fields were replaced by the GBUA's from FLENUMWEACEN Monterey.

(4) TYFOON - analog weighted mean track.
(See Chapter V for technique evaluation.)

4. FORECASTING PROCEDURES

a. TRACK FORECASTING:

An initial track based on persistence blended subjectively with climatology is developed for a 3-day period. This initial track is subjectively modified by the following:

(1) Recent steering is evaluated by considering the latest upper air analyses as representative of the average upper air flow over the past 24 hours. (The latest upper air analyses are about 12 hours old, thus roughly representing the mid-point of the last 24-hour time interval.) By this technique actual past 24-hour movement serves to indicate the best steering level as well as the effectiveness of steering.

(2) Objective techniques are considered, with the techniques being ranked according to their past performance on similar storms.

(3) Twenty-four hour height-change analyses are evaluated for forecast track/speed changes (Hoover, Devices for Forecasting Movement of Hurricanes, Manuscript of the U.S. Weather Bureau, 1957).

(4) The prospects of recurvature are evaluated for all westward moving storms. The basic requisites for this evaluation are accurate continuity on mid-latitude troughs and numerical progs to indicate changes in amplitude or movement. Relative position and strength of the subtropical ridge and northward tendency due to internal forces are also important considerations.

(5) Finally, a check is made against climatology to ascertain the likelihood of the forecast. If the forecast track is climatologically unusual, a reappraisal of the forecast rationale is conducted and adjustments made if warranted.

b. INTENSITY FORECASTING:

Intensity forecasts are extrapolated linearly and modified by climatology where necessary. This modification is made after considering upper tropospheric evacuation, 850 mb-700 mb temperatures, sea surface temperatures, and possible terrain influence.

5. WARNINGS

Tropical cyclone warnings are numbered sequentially. If warnings are discontinued and the storm reintensifies, as Tropical Storm Grace did this year, warnings are numbered consecutively from the last warning issued. Amended or corrected warnings are given the same number as the warnings they modify. Forecast positions are issued at 0000Z, 0600Z, 1200Z, and 1800Z as follows:

Tropical Depressions	12 hr and 24 hr
Typhoons and Tropical Storms	12 hr, 24 hr, 48 hr, and 72 hr

Forecast periods are stated with respect to warning time. Thus a 24-hour forecast verifies 26-1/2 hours after the aircraft fix data, 30 hours after the latest surface synoptic chart and 30 or 36 hours after the latest upper air charts.

Warning forecast positions are verified against the corresponding post analysis "best track" positions. A summary of results from 1972 is presented in Chapter V.

6. PROGNOSTIC REASONING MESSAGE

Whenever warnings on typhoons and tropical storms are being issued, a prognostic reasoning message is released at 0000Z and 1200Z. This message is intended to provide the reasoning behind the latest JTWC forecasts.

7. TROPICAL WEATHER SUMMARY

This message is issued daily from 1 May through 31 December and otherwise when tropical cyclogenesis is forecast or observed. It is issued at 0600Z and describes the location, intensity and likelihood of development of all tropical low pressure areas and significant cloud masses detected by satellite.

8. TROPICAL CYCLONE FORMATION ALERT

Alerts are issued when the formation of a tropical cyclone is considered possible or probable. These messages are issued as required and are valid for up to 24 hours unless cancelled, superseded or extended.